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# New Beats Old Nearly Every Day: The Countervailing Effects of Renovations and Obsolescence on Hotel Prices

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# New Beats Old Nearly Every Day: The Countervailing Effects of Renovations and Obsolescence on Hotel Prices

## Abstract

As is the case with other commercial real estate types, hotels begin to depreciate from the time they open, in a process largely driven by functional obsolescence. Unlike other asset types, however, hotel values hit an inflection point at which they begin to rise again. Average annual depreciation for the 3,810 chain-affiliated hotels in this sample was within the range found in other commercial types of real estate. Depreciation rates start off relatively brisk in the first few years, because hotel owners typically do not begin renovations until around year ten. When owners do begin renovation, those expenditures slow but do not stop the decline in the typical hotel's value. Then, around year twenty-eight, the depreciation reverses for hotels that are still in business. Not only have renovations stabilized the loss in value, but other, unknown factors promote the hotel's value—a phenomenon that could be called a vintage effect. Such fully depreciated properties may be located in particularly favorable sites, or they may have architectural or other features that make them attractive to investors.

## Keywords

hotels, renovation, commercial real estate, depreciation, vintage effect

## Disciplines

Business | Hospitality Administration and Management

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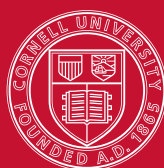


## New Beats Old *Nearly* Every Day: The Countervailing Effects of Renovations and Obsolescence on Hotel Prices

Cornell Hospitality Report

by John B. Corgel

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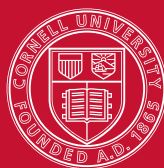
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# The Countervailing Effects of Renovations and Obsolescence on Hotel Prices

By John B. Corgel, Ph.D.

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## ABOUT THE AUTHOR

The founding director of the Cornell Center for Hospitality Research, John B. Corgel, Ph.D., is Robert C. Baker Professor of Real Estate at the Cornell University School of Hotel Administration (jc81@cornell.edu). Formerly a visiting scholar at the Federal Home Loan Bank Board in Washington, D.C., he is a fellow of the Homer Hoyt Institute. He also maintains a consulting relationship with PKF Hospitality Research, where he is helping to develop new products for the hotel industry based on property-level financial performance information. He is the author of over 65 articles in academic and professional journals, including *Real Estate Economics*, *Journal of Urban Economics*, *Journal of Risk and Insurance*, *Journal of the American Business Law Association*, and *Cornell Hospitality Quarterly*. His textbook, *Real Estate Perspectives* (with Smith and Ling), was used throughout the nation for introductory real estate courses. An academic version of this paper is published as: John B. Corgel, "Technological Change as Reflected in Hotel Property Prices," *Journal of Real Estate Finance and Economics* Vol. 34, No. 2 (2007), pp. 257–279.



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## EXECUTIVE SUMMARY

**A**s is the case with other commercial real estate types, hotels begin to depreciate from the time they open, in a process largely driven by functional obsolescence. Unlike other asset types, however, hotel values hit an inflection point at which they begin to rise again. Average annual depreciation for the 3,810 chain-affiliated hotels in this sample was within the range found in other commercial types of real estate. Depreciation rates start off relatively brisk in the first few years, because hotel owners typically do not begin renovations until around year ten. When owners do begin renovation, those expenditures slow but do not stop the decline in the typical hotel's value. Then, around year twenty-eight, the depreciation reverses for hotels that are still in business. Not only have renovations stabilized the loss in value, but other, unknown factors promote the hotel's value—a phenomenon that could be called a vintage effect. Such fully depreciated properties may be located in particularly favorable sites, or they may have architectural or other features that make them attractive to investors.

New Beats Old *Nearly* Every Day:

# The Countervailing Effects of Renovations and Obsolescence on Hotel Price

By John B. Corgel, Ph.D.

**T**he large volume of hotel real estate transactions completed during the past several years signifies the culmination of an important change occurring in the lodging sector, in which hotel operations have become separate from property ownership. Major hotel companies that held and managed properties have been net sellers of those properties as they seek growth from domestic and international management and franchise contract expansion, while leaving others to realize the value of the real estate. This so-called “asset lite” strategy also was motivated by unprecedented escalation of real estate prices, coupled with an intense interest in real estate as an investment.<sup>1</sup> Property buyers included traditional and new hotel investors, such as private equity funds and non-hotel REITs. These investors recognized opportunities for excess returns despite historically high prices.

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<sup>1</sup> See: “Asset Lite or Asset Right?,” *Hotels Investment Outlook*, June 2006, pp. 22–24.



Substantial property transaction volume represents a movement toward greater efficiency in the industry as new owners find creative ways to enhance profits. Ironically, record transaction volume also represents considerable disagreement about future asset price paths, since every hopeful buyer is matched by a willing seller. As they decide whether to dispose of or acquire properties, both sellers and buyers naturally concentrate on the assets' present values from discounted cash flow (DCF) models and the recent sale prices of comparable properties as benchmarks. Future sale prices receive some attention in DCF models, but relatively insignificant components of periodic cash flows often are given far more attention. Despite the importance of future prices to decisions regarding acquisition and disposition of hotel assets, the worlds of institutional investment and real estate investment research have been curiously ambivalent about understanding the determinants of future prices beyond cash flows.

One way to think about the prospective prices of hotel properties is to separate the factors that will cause properties to appreciate from those that would be expected to cause property prices to decline. We can express that concept as follows. Say that  $P_t$  represents the current price in period  $t$ ,  $P_{t,n}$  the future price,  $a$  the average appreciation rate from  $t$  to  $n$  for hotels reaching stabilized occupancy, and  $d$  the average rate of economic depreciation from  $t$  to  $n$ . The relationship between current prices and future prices can be specified as follows:

$$P_{t,n} = P_t(1 + a) - P_t(1 + d) \quad [1]$$

Now say that  $P_t$  equals \$10 million, the holding period ( $n$ ) is one year,  $a$  is estimated at 7 percent, and  $d$  is expected

to be 2 percent. With those values, the future price  $P_{t,n}$  would be \$10.5 million, calculated as follows:

$$\$10 \text{ million} (1 + .07) - \$10 \text{ million} (1 + .02). \quad [2]$$

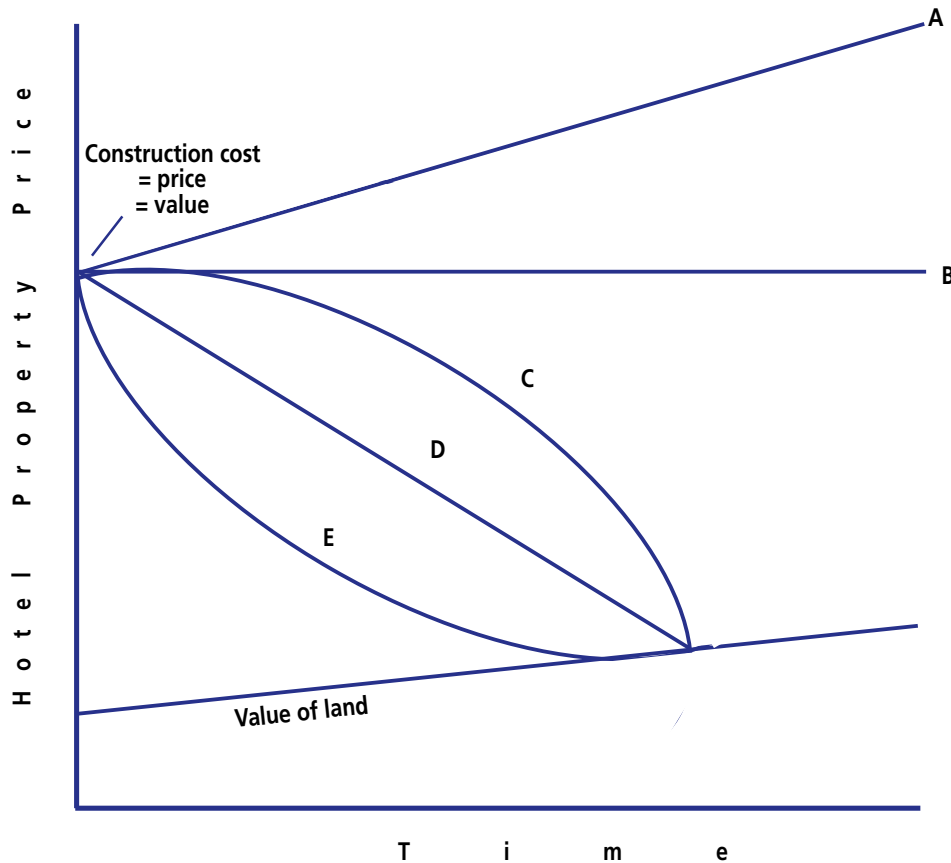
I discuss here the several determinants of the appreciation rate, which has a number of alternative treatments in research and practice. In contrast to the multiple determinants to appreciation, depreciation is mainly driven by the age of the property. In this report I analyze the relationship between hotel prices and the age of property with the idea of sharing insights into future price patterns of properties of various ages to allow buyers and sellers to make better investment decisions. Also, the results presented in this report should assist owners who plan to hold their properties in making informed renovation decisions.

### Conventional Wisdom about Property Prices and Age

The conventional wisdom regarding a hotel's age and its value is that the prices of hotels naturally fall as the properties age, holding others factors constant. As a related issue, then, if a hotel's value does decline with age, I wanted to determine whether that depreciation is a straight line or whether hotel price changes show some kind of curve. Asset values could, for instance, rapidly decline early in their operating lives, similar to the depreciation of new automobiles, or, perhaps a hotel asset's value plummets at the end of its life, after a long, steady decline. Determining the nature of hotel price depreciation requires a set of arguments for understanding the conceptual relationships between time, hotel prices, and major renovations that are aimed at retarding age-related price erosion. This report presents empirical research to develop numerical estimates of the price and age relationship.

**EXHIBIT 1**

Possible curves to describe depreciation (d), or changes in hotel prices as a property ages



Based on the study's findings, I offer implications regarding the relationship between the prices of hotel properties for the benefit of asset owners and potential buyers.

### The Basics of Real Estate Depreciation

The standard economic theory of real estate depreciation, which is defined as "the reduced ability of an asset to generate future cash flows," holds that financial benefits erode as properties naturally age and as market conditions change.<sup>2</sup>

<sup>2</sup> G.W. Blazenko and A.D. Pavlov, "The Economics of Maintenance for Real Estate Investments," *Real Estate Economics*, Vol. 32, No. 1 (2004), p. 57: "The many studies of capital asset depreciation performed during the past four decades greatly advanced the state of knowledge about how real estate loses its ability to produce future service or cash flows over time and about how to empirically measure the rate of economic depreciation." For a review of the early housing literature, see: S. Malpezzi, L. Ozanne, and T.G. Thibodeau, "Microeconomics Estimates of Housing Depreciation," *Land Economics*, Vol. 63, No. 4 (1987), pp. 372–385. An updated review appears in: B.C. Smith, "Economic Depreciation of Residential Real Estate: Microlevel Space and Time Analysis," *Real Estate Economics*, Vol. 32, No. 1 (2004), pp. 161–180. A recent discussion of research on the economic depreciation of commercial property is found in: T.J. Dixon, N. Crosby, and V.K. Law, "A Critical Review of Methodologies Measuring Rental Depreciation Applied to Commercial Real Estate," *Journal of Property Research*, Vol. 16, No. 2 (1999), pp. 153–180.

Physical deterioration and the readily apparent result of aging increase operating expenses, thus lowering cash flow. The effect on cash flows from obsolescence, which "results when older things function as when they were new but otherwise lose their appeal or usefulness," is less apparent.<sup>3</sup> Note that an obsolescent hotel is still operable, even if it is no longer fashionable.

The *Appraisal of Real Estate* identifies the following two types of obsolescence: functional and external. Functional obsolescence usually occurs because of changes in consumer preferences for physical features inside the property. These preferences are satisfied by technological changes introduced into competing properties. Economists refer to a variation of functional obsolescence as technical obsolescence. In either case, technological change instigates obsolescence.

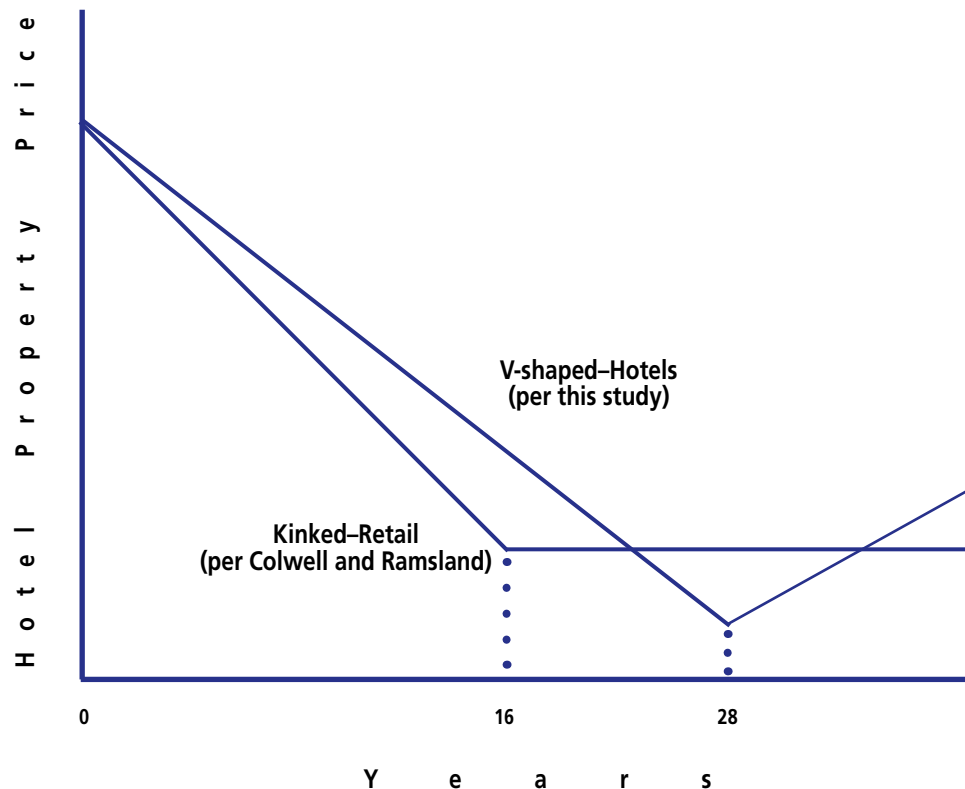
Businesses such as hotels, which operate at fixed locations within an integrated real estate market, may experience external or locational obsolescence.<sup>4</sup> This form of

<sup>3</sup> S.E. Margolis, "Depreciation and Maintenance of Houses," *Land Economics*, Vol. 57, No. 1 (1981), p. 91.

<sup>4</sup> Appraisal Institute, *The Appraisal of Real Estate*, 13th Edition (Chicago: Appraisal Institute, 2008).

## EXHIBIT 2

### Depreciate curves for retail and hotel properties based on empirical studies



See: P.F. Colwell and M.O. Ramsland, "Coping with Technological Change: The Case of Retail," *Journal of Real Estate Finance and Economics*, Vol. 26, No. 1 (2003), pp. 47–63.

obsolescence derives from factors external to the property, for example, an oversupplied market, or adjacent-parcel environmental contamination. Price effects due to external obsolescence generally do not result from technological change.

#### Research Indicates Complex Relations between Real Estate Prices and Asset Age

Colwell and Ramsland demonstrate how technological change, as the underlying cause of property obsolescence, affects retail real estate prices.<sup>5</sup> They argue that even during the years immediately following a new property's opening, changing technologies begin to push that property toward obsolescence. Because renovations are seldom undertaken early in a hotel's life, obsolescence may be observed during this interval without the offsetting effects of capital expenditures for major renovations targeted to defeat obsolescence.

<sup>5</sup> P.F. Colwell and M.O. Ramsland, "Coping with Technological Change: The Case of Retail," *Journal of Real Estate Finance and Economics*, Vol. 26, No. 1 (2003), pp. 47–63.

Colwell and Ramsland find empirical support for the main hypothesis derived from theory.<sup>6</sup> They calculated that functional obsolescence during the initial sixteen years of a retail property's operation is 1.7 percent per year. By contrast, the long-run rate of commercial property obsolescence is 0.9 percent per year. These estimates support the concept that obsolescence, assuming a constant rate of technological change, can be directly observed early in the life of properties in the absence of renovation expenditures. Moreover, their numbers imply that renovations to retail properties are effective in eliminating approximately one-half of all functional obsolescence in a commercial property.

Exhibit 1 shows five possible paths that  $P_{t,n}$  from Equation [1] may follow over time, depending on the assumptions one applies. Note particularly the behavior of  $d$  (the depreciation rate) in paths C, D, and E, in which price always declines with the passage of time. Current Federal tax law uses Path D as its assumption for depreciation calcula-

<sup>6</sup> *Ibid.*

**EXHIBIT 3****Capital expenditure patterns by age of hotel property****Panel A**

Ratio of capital spending to total revenues by age of property and market segment

Study					
Full Service					
1995		2000		2007	
Built before 1981	9.6%	Built before 1983	6.4%	Built before 1990	5.4%
Built between 1981 & 1986	4.3%	Built between 1983 & 1993	6.5%	Built between 1990 & 2000	3.5%
Built after 1986	2.6%	Built after 1993	0.9%	Built after 2000	2.3%
Select Service					
1995		2000		2007	
Built before 1981	5.2%	Built before 1983	6.5%	Built before 1990	8.7%
Built between 1981 & 1986	4.0%	Built between 1983 & 1993	4.8%	Built between 1990 & 2000	2.9%
Built after 1986	2.3%	Built after 1993	3.0%	Built after 2000	0.7%

**Panel B**

Range of average annual capital expenditures for all hotels, by age (2000)

Age in Years	Minimum	Maximum
1	1.65%	4.51%
2	1.72%	3.29%
3	1.43%	3.15%
4	1.31%	3.64%
5	3.21%	6.23%
6	4.80%	6.77%
7	4.15%	5.85%
8	3.60%	5.23%
9	4.83%	7.01%
10	8.43%	11.94%
15	3.35%	5.72%
20	2.37%	8.68%
25	5.05%	10.24%

tions for tax purposes. Properties placed into service now must be depreciated using the straight-line method, although the depreciation periods vary for different classes of commercial property. For example, the period is 27.5 years for multi-family properties and 39 years for other commercial properties, including hotels. In contrast, economic research and feasibility studies assume a concave path, such as Path C, for depreciation.

You'll note that the graph in Exhibit 1 shows only simple and relatively smooth patterns. In reality, depreciation patterns show combinations of all five of those paths. The obsolescence function estimated with retail property data by Colwell and Ramsland, for instance, has the kinked shape shown in Exhibit 2, on the previous page. They find that, holding other factors constant, existing retail properties prices always decline as they mature relative to newer properties. Indeed, as I explain below, I found that hotel

depreciation generally follows the V-shaped depreciation curve shown in Exhibit 2, in contrast to the one that Colwell and Ramsland identified for retail properties.

**Summary of Statistical Results from this Study**

Having said that hotel depreciation follows a V-shaped curve, I note that the data in this study yield distinctive results regarding the relationship between a hotel property's price and its age. To begin with, the estimated rate of hotel property obsolescence following construction is 1.9 percent per year, which aligns with the retail property estimate of 1.7 percent. However, the breakpoint for when this gradual decline ends does not occur until year 28, compared to year 16 for retail properties, as identified by Colwell and Ramsland. The late date for the inflection point occurs despite substantial follow-on investment in hotels, which begins around year 10 and continues to increase thereafter.

The hotel data indicate that renovation investments do not significantly restrain price declines that stem from technological change fairly until late in a hotel's economic life. After the breakpoint, the sale price appreciates by a surprising 0.7 percent per year. Combining the two numbers yields a rough estimate for the long-run obsolescence rate of 1.23 percent. An evaluation of the equation with statistical results from this study (presented later in this report) at the average age of eighteen years indicates an obsolescence rate of 1.35 percent. Both estimates modestly exceed the 0.9 percent found for retail real estate.

I explain the upward sloping portion of the V-shaped depreciation function presented in Exhibit 2 as a "vintage effect" driven by a demand for surviving hotels. Goodman and Thibodeau find a similar effect in housing markets.<sup>7</sup> They attribute this result to some distinctive characteristic of the house or neighborhood that is correlated with age. Buyers may be willing to pay a premium for large porches on older homes, for instance, or houses near employment centers may be in demand because they offer economies in transportation costs. Similar design or location factors may be responsible for the positive price-age relationship for hotels after the inflection point, but further investigation of this phenomenon is not a part of the study reported here.

## Technological Change and Hotel Properties

Even though the use pattern for hotels differs from that of other commercial real estate, the large volumes of customers who regularly pass through both hotels and retail establishments represent a common trait that makes both retail and hotel real estate particularly vulnerable to technological change. Colwell and Ramsland identify the following categories of technological change in retail real estate: physical (e.g., building materials and security cameras), contractual (e.g., percentage leases and commercial mortgage backed securities debt, CMBS), and process innovations (e.g., live demonstrations).<sup>8</sup>

The hotel industry has experienced numerous innovations during the past few decades. From a design perspective, suite-style rooms increased in number relative to traditional rooms, exterior-corridor hotels almost disappeared in favor of interior corridors, atrium entrances gained (and lost) popularity, and the movement toward more wired and wireless environments has been a design focal point. Contractually, numerous advancements have occurred to strengthen management and franchise relationships. The manner in which food and beverage service delivery has evolved toward

self-service (or vanished entirely in the mid-price segment) represents an example of process change in hotels.

Concerns by owners and managers about how much money should be spent or put into reserve to keep hotels competitive prompted three surveys of hotel capital expenditures since 1995, conducted by the International Society of Hospitality Consultants. The ISHC asks questions about actual expenditures for the following categories:<sup>9</sup>

- Updating design and décor,
- Curing functional and economic obsolescence, thereby extending both the physical and economic life of the asset,
- Complying with franchisors' brand requirements,
- Technological improvements,
- Product changes to meet market demands,
- Adhering to government regulations, and
- Replacing all short- and long-lived building components due to wear and tear.

Unfortunately, these reports do not identify expenditures by specific purpose.<sup>10</sup>

As shown in Panel A of Exhibit 3, the 2007 report summarizes capital expenditure ratios, age of property, and market segment from the three ISHC surveys. Expenditures at full-service hotels either have exceeded or equaled those at select-service hotels, except in the most recent survey for the oldest age category. Expenditure patterns by age of all hotels, as shown in Panels A and B, confirm that relatively small amounts of capital are spent during the initial years following construction. Expenditures and expenditure variances increase steadily thereafter. In addition, expenditures tend to be concentrated at points in the property life cycle when renovations occur (e.g., year 10). The 2007 ISHC report shows expenditure spikes for full-service hotels in years 6 and 14, with a large spike at year 23.

Finally, property obsolescence is filtered by a hotel's affiliation with a recognized hotel company's brand. Hotel chains incur substantial monitoring costs to prevent properties from becoming obsolete. Consequently, responses to changing technology occur fairly rapidly, incrementally, and uniformly across brands within the same company and across competing companies. These conditions create an environment different from other property types with regard to technological change and obsolescence.

<sup>9</sup> *CapEx: A Study of Capital Expenditures in the U.S. Hotel Industry* (Memphis, TN: International Society of Hospitality Consultants, 1995); *CapEx: A Study of Capital Expenditures in the U.S. Hotel Industry* (Memphis, TN: International Society of Hospitality Consultants, 2000), p. 2; and *CapEx: A Study of Capital Expenditures in the U.S. Hotel Industry* (Alexandria, VA: International Society of Hospitality Consultants, 2007).

<sup>10</sup> The reports do present detail on expenditures at various locations within the hotel (e.g., the lobby) and for specific items (e.g., wall coverings).

<sup>7</sup> A.C. Goodman and T.G. Thibodeau, "Age-Related Heteroskedasticity in Hedonic House Price Equations," *Journal of Housing Research*, Vol. 6, No. 1 (1995), pp. 25–42.

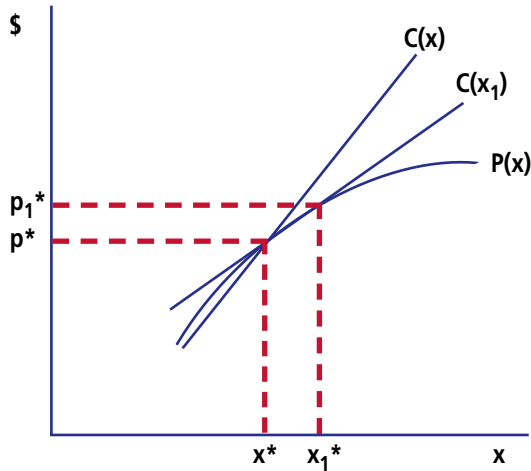
<sup>8</sup> Colwell and Ramsland, *op.cit.*

# EXHIBIT 4

## Models of the effects of technological obsolescence and vintage attributes on hotel prices

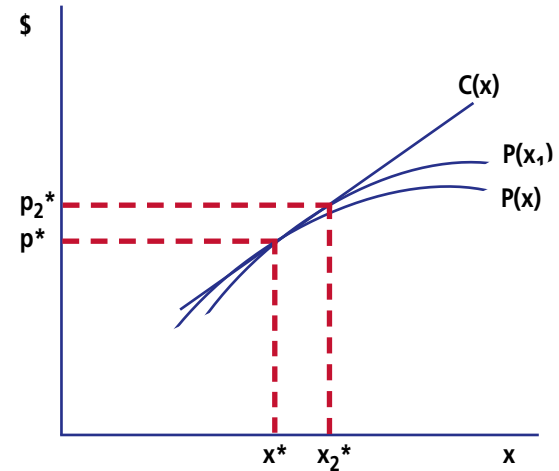
Panel A

Price effects of technological change, or obsolescence



Panel B

Price effects of vintage attributes



### Conceptual Model of Optimal Property Configurations

I begin the conceptual story that underlies the statistical analysis of hotel properties' price changes with age by assuming that the cost of building hotels increases linearly as more rooms and amenities are added, but that the value or purchase price of hotels levels off and ultimately diminishes as more rooms and amenities populate the market (i.e., diminishing marginal utility). Both the construction cost and purchase price originate from a collection of the property attributes (notably, location, type of rooms), signified as  $x$ . Thus,  $C(x)$  represents the cost of placing a new property in service with a modern collection of  $x$  attributes,

By assuming that  $P(x)$  represents the current price of property in service with quantities of  $x$  attributes, the equilibrium solution involves determining the property attribute configuration,  $x^*$ , that maximizes net present value, or  $PV(x)$ . This is the optimal property configuration. Further, a competitive market is assumed so that  $P(x) = PV(x)$ , and, therefore:

$$P(x^*) = C(x^*) \quad [3]$$

The property's purchase price and construction cost functions reach a point of tangency at the optimal property configuration. Obsolescence price effects (negative) and vintage

price effects (positive) appear as movements in opposing directions from the optimal configuration. New optimal configurations arise, therefore, either because of shifts in the cost curve due to changes in input prices and technology or because of shifts in the price curve from demand-related repricing of attributes and from changes in expenses associated with owning the attributes.

Exhibit 4, Panel A shows the optimal configuration of a new property,  $x^*$ , at the intersection of  $C(x)$  and  $P(x)$ . An increase in costs resulting from advancements in technology, for example, shifts the cost curve to  $C(x_1)$ , thereby producing optimal configuration  $x_1^*$ . The higher revenue earned from properties with  $x_1^*$  relative to  $x^*$  translates into price differential  $p_1^* > p^*$ . Most seasoned properties continue to operate with obsolete configuration  $x^*$  prior to renovation.

Unanticipated market changes appear as different configurations for seasoned properties relative to new properties. Typically, older property configurations produce lower prices than do newer property configurations, and the increment of depreciated price reflects the extent of a seasoned property's obsolescence. A portion of this price differential comes from technological change, while the balance comes from such other depreciation drivers as physical deterioration and external obsolescence. Isolating



**EXHIBIT 5****Descriptive statistics for hotel property transaction sample****Panel A****Statistics for Selected Variables**

Variable	Symbol	N	Mean	$\sigma$	Minimum	Maximum
Sale Price	P	3,810	\$12.4 M	\$24.6M	\$.5M	\$365M
Number of Rooms	RM	3,810	167	155	20	2940
Age	A	3,810	18	15	1	202
Published Room Rate	R	3,810	\$94.18	\$61.23	\$19	\$950
Per Capita Income	PI	3,810	\$26,572	\$13,799	\$6,428	\$148,052

**Panel B****Statistics by Category**

Category	Sale Price Symbol	N	Mean	$\sigma$	Minimum	Maximum
Market Segment						
Deluxe	DEL	44	\$105M	\$73.7M	\$8.5M	\$355M
Luxury	LUX	409	\$46.3M	\$45.9M	\$1.8M	\$365M
Upscale	UPS	400	\$19.7M	\$15.1M	\$1.2M	\$96M
Upper-Tier Extended Stay	UES	92	\$12.4M	\$7.6M	\$1.2M	\$74.5M
Midscale W/ F&B	MW	753	\$7.1M	\$7.6M	\$.6M	\$80M
Lower-Tier Extended Stay	LES	237	\$5.1M	\$3.9M	\$.6M	\$26.7M
Midscale W/Out F&B	MWO	800	\$4.8M	\$3.8M	\$.5M	\$52M
Economy	ECO	586	\$3.2M	\$3.5M	\$.5M	\$5.3M
Budget	BUD	489	\$2.5M	\$1.6M	\$.5M	\$10.5M
AGE CATEGORY						
Zero to Ten Years	N/A	1274	\$12.4M	\$21.6M	\$.5M	\$275M
11 to 20 Years	N/A	1237	\$12.1M	\$23M	\$.5M	\$355M
21 to 30 Years	N/A	694	\$11.9M	\$25.5M	\$.6M	\$321M
31 to 40 Years	N/A	404	\$8.5M	\$23.3M	\$.5M	\$365M
Over 40 Years	N/A	201	\$23.3M	\$42M	\$.5M	\$243M
YEAR OF SALE						
1996	T96	462	\$14.2M	\$21.4M	\$.5M	\$198M
1997	T97	499	\$15.1M	\$23.1M	\$.5M	\$190M
1998	T98	404	\$17.5M	\$29.9M	\$.7M	\$197M
1999	T99	372	\$12.1M	\$25.8M	\$.5M	\$275M
2000	T00	502	\$10.2M	\$26.4M	\$.5M	\$365M
2001	T01	407	\$9.9M	\$23M	\$.6M	\$250M
2002	T02	390	\$8.2M	\$17.9M	\$.6M	\$214M
2003	T03	463	10.9M	\$22.9M	\$.5M	\$321M
2004	T04	311	13.1M	\$30.9M	\$.5M	\$355M

the contribution that technological change makes to property obsolescence requires empirical models that include variables to control for these other determinants of overall economic depreciation.

The process of property obsolescence is complicated by any shifts in the price curve, for example, due to demand-related repricing of  $x$  attributes. Panel B of Exhibit 4 shows an upward shift of the price function from  $P(x)$  to  $P(x_1)$  without technological change. An increase in the demand for seasoned properties with  $x_2$  attributes means that these properties command  $p_2$ , where  $p_2 > p^*$ . These properties thus benefit from a vintage effect.

**Empirical Study**

The transaction data consist of 3,810 hotel real estate sales that occurred throughout the U.S. from January 1996 through early 2004. Information about property sale prices and characteristics come from a database managed by PKF Hospitality Research. This firm obtains hotel transaction information through subscriptions with CoStar and Hotel Brokers International. Transactions data also come from industry publications, news reports, and the firm's consultants. This firm researches sales to verify and to fill in missing information. Demographic data, such as ZIP code per capita income, come from CACI.

Starting with these data I removed full-service properties with fewer than 75 rooms, limited-service properties with under 20 rooms, and any hotel with a sale price of less than \$500,000. Rather than treat conference center and resort hotels as separate categories, I merged them into the appropriate full-service segments. Finally, I retained only hotels with a nationally recognized brand affiliation and screened out properties with either no affiliation or a regional brand. This step ensures reasonable consistency in the sample with respect to maintenance, repairs, and, to a lesser extent, renovation.<sup>11</sup>

Definitions of the variables and their summary statistics appear in Exhibit 5, on the previous page. Transactions are evenly distributed by the year of sale and by market segment. Market segment assignments for each property are based on PKF Consulting's assessment of its brand homogeneity, and, thus, like collections of property characteristics. As shown in Exhibit 5, the deviations of sale prices from the mean of \$12.4 million are considerable. Using a price-per-room calculation narrows this variation for estimation purposes.

### Summary of Age Statistics

The average age of the properties in the study is 18 years, with a standard deviation of 15 years. As shown in Exhibit 5, two-thirds of the transactions involved hotels up to age 20, although every age cohort up to 40 years has at least 400 transactions. The hotels under 20 years old tended to be smaller than the sample average and, not surprisingly given trends in hotel development during the past 25 years, those relatively new hotels were heavily represented in the luxury, mid-price without food and beverage, and upscale segments. By contrast older hotels were heavily represented in the mid-price with food and beverage segment. In sum, the sample of property transactions used for this study appears to resemble the population of U.S. hotels in operation during the study period.

### Transaction Price Equation

The price model represents hotel property sale price as a function of various property characteristics,  $X_i$ , and overall property depreciation. That is,

$$P_i = f(X_i, \text{Overall Depreciation}) \quad [4]$$

Real estate appraisers divide depreciation into the following three categories: physical deterioration (i.e., normal wear and tear), external obsolescence (i.e., location or economic), and functional obsolescence. Property age accounts for price variation due to functional obsolescence, if controls

<sup>11</sup> Monitoring of these standards occurs through inspections and an institutional process known as the Property Improvement Program (PIP). If a hotel has been 'PIPed', then the property meets all of the current standards of the sponsoring company. This event ordinarily involves technology and other physical upgrades, all except extensive renovations.

## EXHIBIT 6

### Variables used in hotel price regression equation

#### DEPENDENT VARIABLE

Natural log of sale price divided by number of rooms (price per room)

#### INDEPENDENT VARIABLES

##### Focus Variables

1. Age of Property at Time of Sale (A)
2.  $A^2$

##### Control Variables

3. Series of Dummy variables (1, 0) for Hotel Market Segments (MS)
4. Series of Dummy Variables for U.S. States (S)
5. Personal Income of ZIP Code in which Property is Located (PI)
6. Adjusted Published Room Rate (R)
7. Year Property Sold (T)

appear in the estimating equation to measure physical deterioration (i.e., condition) and external obsolescence, such that the price equation now becomes

$$P_i = f(X_i, \text{Age, Condition, Location}) \quad [5]$$

The data base available for this study generally lacks details on the properties' attributes beyond the number of rooms and age. However, each segment has its own set of attributes that must be controlled through a fixed-effects treatment of each of the nine market segments. Thus, the equation requires a separate dummy variable for each market segment, as well as a dummy variable for properties with all-suite rooms. As mentioned earlier, market segment designations are assigned according to consistency of property attributes. Note that the size of the hotel as measured by the number of rooms ( $RM_i$ ), which often accounts for 30 percent or more of the variation in hotel sale prices, enters on the left side of the equation through the price-per-room variable.<sup>12</sup> Thus,

$$(P_i / RM_i) = P_i = f(X_i, \text{Age, Condition, Location}) \quad [6]$$

Adjustments for condition occur in two ways. First, limiting the sample to nationally affiliated hotels provides consistency for physical condition. This does not mean that every affiliated property has exactly the same level of deferred maintenance, only that the level of deferred maintenance does not substantially exceed that of other properties in the same brand and segment. In short, the obsolescent and often decrepit properties that have lost their flag are not included here. Differences among non-homogeneous brands are picked up by the market segment variable.

<sup>12</sup> See: J.B. Corgel and J.A. deRoos, "The ADR Rule-of-Thumb as Predictor of Lodging Property Values," *International Journal of Hospitality Management*, Vol. 12, No. 4 (1994), pp. 353-365.

Second, the instrumental variable,  $R_t^A$ , which is derived from the published room rate, contains information related to the condition of the property.<sup>13</sup> The transaction database contains the published room rate for double occupancy, which overstates the actual average daily rate, but is positively and highly correlated with realized ADR.<sup>14</sup> If directly introduced into the price equation, the published room rate provides an effective control for quantity, quality, and condition differences among the rooms and properties in this sample. Published room rate, however, contains a serious statistical problem, because it correlates closely with other explanatory variables, such as the age of the property, and with the equation error term. Consequently, I instituted econometric procedures to adjust published room rate and create an instrumental variable so that this variable can be used in the price equation without violating statistical rules.

Location adjustments are accomplished in a general way with fixed-effects treatment of the states in which the property sale occurred. More specifically, the per capita income level for each property's ZIP code serves as a measure of locational obsolescence. Many of the ZIP codes with the lowest per capita income in this data base are in and around downtown areas, for example.

Both  $A$  and  $A^2$  enter the equation assuming a concave relation between asset price per room and age such that the expected sign of  $A$  is negative and the sign of  $A^2$  is positive. The coefficients on the age variables would normally indicate the rate of economic depreciation in hotels. Due to the controls in this model, however, age coefficients instead indicate the extent to which hotel properties lose value as a consequence of functional obsolescence. Exhibit 6 presents the variables used in the regression model.

Given the assumption that technological change occurs at a constant rate over time, the pure effect of that change on obsolescence can be estimated by comparing data on the sale of recently constructed properties to those of older properties. In this study I replicated the advanced econometric procedure applied by Colwell and Ramsland to find relative obsolescence rates.

## Statistical Results

Exhibit 7 presents the results from estimating the equations presented above using the entire sample of hotel property

<sup>13</sup> An instrumental variable closely substitutes for another variable either because the original variable cannot be collected or its inclusion creates econometric problems.

<sup>14</sup> Due to seasonal variation in room rates, industry analysts generally make cross-sectional comparisons using an annualized rate. Thus, when a hotel sale occurs and the room rate is identified that rate will be an annual average. The published rates in these data are annual averages of seasonal rates cited in travel guides. Annualized published rate and ADR are highly correlated (about 0.9), differing mostly by a scale factor.

### EXHIBIT 7

#### Regression results for all hotels

Dependent Variables		ln(P/RM)	
Variable	Label	Coefficient	Std. Error
A	Age at Date of Sale	-.0171*	.0012
A <sup>2</sup>	Age Squared	.0001*	.0001
R <sup>A</sup>	Published Rate Instrument	.1534*	.0083
PCI	ZIP Per Capita Income	.0001*	.0001
DEL	Deluxe	2.0296*	.0840
LUX	Luxury	1.1722*	.0358
UPS	Upscale	.8131*	.0364
UES	Lower-Tier Extended Stay	.1904*	.0583
MW	Midscale W/ F&B	.2537*	.0318
LES	Upper-Tier Extended Stay	1.0261*	.0412
MWO	Midscale W/Out F&B	.2983*	.0309
ECO	Economy	.0300	.0367
AS	1= All Suites	.2931*	.0367
T97	1 = Sold in 1997	.1467*	.0330
T98	1 = Sold in 1998	.2145*	.0352
T99	1 = Sold in 1999	.1808*	.0364
T00	1 = Sold in 2000	.1643*	.0339
T01	1 = Sold in 2001	.1709*	.0357
T02	1 = Sold in 2002	.1231*	.0364
T03	1 = Sold in 2003	.1193*	.0365
T04	1 = Sold in 2004	.1387*	.0387
C	Intercept	10.2624*	.1968
(S1,...,Sj)	States	(Not Shown)	
R <sup>2</sup>	Adjusted	.5347	
RMSE	Root Mean Square Error	.5113	

Note: \* Significant at  $p < .01$ . Ln is the natural log.

transactions and standard regression procedures. The independent variables in the model explain 53.47 percent of the variation in the natural log (ln) of price per room. Nearly all of the independent variables in the price equation are significant and have the expected signs. All market-segment variables except one (namely, economy) are statistically significant at the 1-percent level. Note that the coefficients are largest for the highest price market segments (i.e., deluxe and luxury). Also note that the coefficients for all of the T variables have a positive sign, indicating that hotel property prices increased every year relative to 1996 prices, controlling for all other factors in this equation.

The estimated negative sign (which is significant) on the age coefficient and the positive sign (also significant) for age squared in the price-per-room equation confirm a concave relationship between hotel property prices and age. This general pattern appears as Path E in Exhibit 1 and is similar to economic depreciation rate patterns found for other property types.<sup>15</sup> With controls in place for physical condition and external obsolescence, hotels on average decline in price

<sup>15</sup> Blazencko and Pavlov, *op.cit.*; Smith, *op.cit.*; and Dixon, Crosby, and Law, *op.cit.*

## A “vintage effect” counteracts depreciation for the average hotel, usually after about 28 years.

through functional obsolescence at a decreasing rate. Nevertheless, the size of the coefficient on  $A^2$  is quite small. The rate of functional obsolescence in the first year, derived from the coefficients on  $A$  and  $A^2$ , equals 1.69 percent  $(-.0171 + (2(1) * .0001))$ . By year 18, the average of the hotel transaction sample, the obsolescence rate has faded to 1.35 percent  $(-.0171 + (2(18) * .0001))$ . These estimates lie between the long-run rate of obsolescence estimated by Colwell and Ramsland for shopping centers of 0.9 percent and the rate of economic depreciation of 2.7 percent estimated by Fisher *et al.* for apartments. (Note that an economic depreciation rate should exceed the obsolescence rate.)<sup>16</sup>

### Technological Change and Obsolescence

This study also applies the procedure used by Colwell and Ramsland to detect a breakpoint in the price and age function. They introduced a variable in the form  $(A - \bar{A})$ , where  $A$  is the age of the property at time of sale and  $\bar{A}$  is an unknown critical age where a breakpoint occurs. The critical age comes from repeatedly running regressions each time with a successively greater age until  $R^2$  reaches a maximum. Applying this procedure to the hotel property data returned a single critical value of 28 years. The significant coefficient on the age variable decreases from  $-.0171$  to  $-.0193$ . Interpretation of these findings is taken as confirmation of two hypotheses derived from the theory. First, the functional obsolescence observable in asset prices stops at some critical age, and thereafter no additional obsolescence appears

because renovation has already occurred to the extent profitable. Second, a higher rate of functional obsolescence occurs in the early years because renovations do not counteract obsolescence.

Finally, a vintage effect of approximately 0.7 percent is detected following the critical year. By contrast, Colwell and Ramsland found a continuation of price erosion beyond the critical year for other types of commercial property. These two paths were presented in Exhibit 2.

### Summary of Findings and Recommendations

Technological change affects the prices of many seasoned products and assets by accelerating their obsolescence. One purpose of property renovations is to counter obsolescence. The main findings from this research indicate that hotel renovations do, indeed, counter obsolescence. To begin with, the long-run or average annual rate of obsolescence for the typical hotel lies between 1.23 and 1.35 percent. Stated differently, the typical hotel tracking along a straight-line path would be totally obsolete in 77 years  $(1/77 = 1.3 \text{ percent})$ . Having said that, I note that typical hotel may be demolished well before the age of 77 due to factors unrelated to technological change and functional obsolescence, such as external obsolescence. The hotel obsolescence rate lies between the obsolescence rate generated from a recent study of retail properties (0.9 percent) and the economic depreciation rate found in another recent study of apartments (2.7 percent).

We see the effects of renovations in the shape of the obsolescence function in this study, which is not a straight line, but is instead concave. Thus, the obsolescence rate exceeds the range given above during the early years of service, because no renovations are typically made on brand-new

<sup>16</sup> J.D. Fisher, B.C. Smith, J.J. Stern, and B. Webb, “Analysis of Economic Depreciation for Multi-Family Property,” American Real Estate and Urban Economics Association, Atlanta, GA, January 4–6, 2002.

properties. The estimates developed in this study indicate a range in the obsolescence rate of 1.7 and 1.9 percent per year for the early years of a hotel's operation. Again using a straight-line-relationship assumption for simplicity, the typical hotel would become obsolete in 56 years ( $1/56 = 1.8$  percent) or sooner if no major renovations were undertaken.

The most telling finding is that the shape of the hotel property obsolescence curve does not follow that of other commercial real estate, because of the inflection point in the curve. Hotel prices fall at a rate of 1.9 percent for the first 28 years of operation then enter a period during which they increase at 0.7 percent per year (until demolition). We could say that during the first 28 years, obsolescence dominates renovations. Hotel industry data indicate that aggressive renovations do not begin until around year ten. The results from this study confirm the merits of such a strategy because obsolescence is not severe during the first ten years of operation. The renovation activity that occurs from years 11 through 28 has the appearance of "swimming upstream." The data indicate that renovations beginning in year eleven keep obsolescence from doing more damage to property prices, but does not prevent aging from inflicting losses in property valuation. On average, renovations offset approximately 0.5 percent per year of price erosion due to obsolescence. Renovations to properties that survive until their twenty-eighth year will more than offset the effects of obsolescence.

## Investor Recommendations

The investment implications of the findings from this study are as follows:

- During periods of rapidly changing technology, the newest and oldest properties are less susceptible to price declines due to aging than are hotels in mid-life.
- Renovation expenditure decisions are the most difficult for properties over 10 years old and less than 30 years old. Money will be well spent on properties in this age group that are positioned in good markets at proven site locations because they will be most likely move to maturity (i.e., 28 years old) and hold their price after that point without extensive investment. Other properties should be allowed to "filter down" the ADR and chain scales with minimal reinvestment.
- Projections of value increases in DCF modeling should directly reflect the age of properties. Two properties in the same market, one 15 years old and the other 30 years old, will be affected differently by age during a subsequent holding period of five to ten years. Counter to conventional thinking, smaller differences between going-in and terminal capitalization rates can be justified for a 30-year-old property than for a comparable 15-year old property. ■

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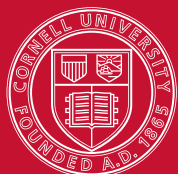
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